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Shop of the 90's Project In-House Machine Tool Evaluation and Machine Tool Evaluation Form (With Instructions)

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U.S. DEPARTMENT OF COMMERCE
Technology Administration
National Institute of Standards
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U.S. DEPARTMENT OF COMMERCE
Rockwell A. Schnabel, Acting Secretary
NATIONAL INSTITUTE OF STANDARDS
AND TECHNOLOGY
John W. Lyons, Director

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I. INTRODUCTION

In 1988, the Fabrication Technology Division (FTD) of the National Institute of Standards and Technology (NIST), implemented a project to modernize and improve small U.S. machine shops and its own machine shop operations, thus creating the "SHOP OF THE 90's" project.

To make the project applicable to small private sector machine shops, advanced experimental hardware and software from NIST laboratories is not used. Only affordable, commercially available, "off-the-shelf" hardware and software is used.

The project is being carried out by using NIST's FTD machine shop as a test bed.

This project is broken down into three tasks:

- 1) Evaluate all machine tools within FTD's shops as to their condition and need for repair. Repair, replace, or surplus any machine tool as cost justification warrants.
- 2) Structure and set up a personal computer network that includes computer aided design and computer aided machining, computer aided cost estimating, computer aided process planning, tool room management, and distributed numerical control.
- 3) Training on new equipment and cross training on existing equipment. All the equipment necessary to make the FTD productive is of little or no use without the trained personnel to operate it properly (the same is true in the private sector). It is therefore necessary that all shop personnel be trained on the hardware, software, and machine tools that are incorporated into the "SHOP OF THE 90's".

This document, a product of the "SHOP OF THE 90's" project, will discuss task 1, machine tool evaluation. This evaluation is not designed to evaluate machine tools for purchase, but to evaluate existing machine tools within the shop.

This task, though the most time consuming, is the most essential part of the project. Without knowing the condition of its equipment, a shop will be unable to evaluate its existing and future workload capacity.

Once existing shop equipment is evaluated, a return on investment can be calculated to allow the shop management to make repair or replace decisions on defective or outmoded equipment.

Appendix A is a sample equipment evaluation form developed during the project. Even though the form seems simple, it contains all the information necessary to assist shop management in making sound decisions and calculating the return on investment on any piece of equipment within a shop.

To illustrate how to use this form refer to the information below and the completed form in Appendix B. This form represents an actual evaluation of one of the numerical control machines in FTD. It contains all necessary information and a completed return on investment calculation.

II. MACHINE INFORMATION

MACHINE # BM4

[This can be any number that the shop chooses. It should be a number that has some meaning. This number within the Main Shop corresponds to the electric panel breaker for FTD emergency shutoff.]

MANUFACTURER Burgmaster Inc.

[This is the maker or brand name of the machine.]

MODEL # 111-25

[This is the manufacturer's model number.]

TYPE OF MACHINE N/C MILL

[This machine is a numerical control mill. For the purposes of the machine evaluation report there is no distinction between computer numerical control and numerical control.]

YEAR OF MANUFACTURE (OR AGE) 1972

[This is the year in which the machine was manufactured.]

H.P. RATING 5

[This is the horse power rating of the spindle motor.]

WORK AREA X 40 Y 20 Z 10 A 10 [X] IN.

[This is the usable work area and axis travel of the machine table and other axis. In this case they are measured in inches.]

MAX. WORK PIECE WEIGHT 2000 LBS.

[This is the total weight that the machine table will hold. Exceeding this weight can cause damage to the machine.]

ESTIMATED USE THROUGHOUT THE YEAR (%) 80

[This is the estimated use of the machine at the time of the initial report. Estimated use includes all the time that a machine is scheduled for work. It also includes setup time, cleanup time, and downtime, if any, due to machine breakage or malfunction. This number will be used in the return on investment calculations on page three of the report.]

III. CONDITION INFORMATION

CONDITION OF MACHINE POOR

[This is the condition that shop management determines the machine is in when the report is being prepared.]

If FAIR or POOR explain.

Because of the age of this machine it has many small problems; spindle runout, override switches, tapers, etc.

[Once a conditional assessment has been made, explain the reasoning behind the assessment.]

If POOR should this machine be: SURPLUSED

[At this point, based on previous information, make a management decision. What will be done with this machine? If the machine will be repaired or any other action taken, the return on investment calculations must backup the decision.]

If REPAIRED or OTHER explain.

The cost of repair and upgrade of this machine is in excess of its market value or cost of replacement.

[Explain the reason behind the decision.]

WHAT TYPE OR CATEGORY OF JOBS SHOULD THIS MACHINE BE USED FOR?

Roughing work, work with tolerances of +/- .005 or greater, non-precision work, drilling.

[Explain what types of jobs the machine should be used for.]

WHAT TYPE OR CATEGORY OF JOBS SHOULD THIS MACHINE NOT BE USED FOR?

Precision work, tolerances of +/- .005 or less.

[Explain what types of jobs the machine should not be used for.]

OTHER COMMENTS:

[This space is for any comments that are pertinent to the evaluation of the machine or any comments that are necessary.]

IV. RETURN ON INVESTMENT INFORMATION

ORIGINAL COST OF MACHINE \$72,222

[This is what the machine cost new.]

YEARS OF DEPRECIATION 15

[It is suggested that five years minimum to ten years maximum be used. Most machines have an average life of ten to fifteen years. An average of seven is the norm when depreciating machinery. This allows for three to eight years of profit on each machine.]

ANNUAL DEPRECIATION \$4,815

[This is the original cost of the machine divided by the number of years the machine was depreciated.]

ANNUAL MAINTENANCE COST \$1,896

[This is the amount of a maintenance contract for this machine or for all machines divided by the number of machines. If no maintenance contract is in force it is suggested that at least one percent of the original machine cost be set aside, in an escrow account, each year to cover maintenance.]

ADDITIONAL MAINTENANCE COST \$23,000

[This is the salary of a maintenance person divided by the number of machines. Calculated into this number is the downtime costs of the machine. This is the time the machine is not working because of maintenance problems and there is a job on or scheduled for the machine. It is calculated by taking the downtime hours times the shop rate.]

ACTUAL ANNUAL MAINTENANCE COST \$24,896

[This is the annual maintenance costs plus the additional maintenance costs, cited previously.]

ANNUAL SET ASIDE FOR REPLACEMENT \$2,889

[There should be some money set aside each year to cover replacement costs of the machine or money to cover the rebuilding of the machine at the end of its useful life. It is suggested that at least ten percent of the original cost be set aside each year, in an escrow account.]

AMOUNT OF REVENUE GENERATED ANNUALLY BY MACHINE \$49,920

[This is the income generated by the machine. It is the number of shop hours (2080 hours per shift), divided by the estimated use (from page one), times the shop rate.]

INCOME DERIVED FROM MACHINE \$18,216

[This is the actual money that the machine made for the shop. It is the amount of revenue generated, minus the annual depreciation, minus the actual maintenance cost, minus the replacement cost set aside.]

It must be pointed out that in filling out the form for machines within the FTD certain important information came to light.

- 1) The suggested depreciation time was exceeded on occasion because when the machine was purchased there was no standard or suggested time.
- 2) The set aside is low, only four percent, because at NIST this is a fixed rate.
- 3) The annual maintenance cost is a fixed amount because there is a maintenance contract in force to cover all shop equipment. This contract is a three year contract.

It is suggested that a copy of page one and two be put into a

manual and placed in the planning/estimating office. This way the planner/estimator is not bidding on jobs or creating process plans for jobs that exceed the capabilities of shop equipment.

Another use we have found for this form is to complete the first page and circulate it among the other shops in the area and encourage them to do the same. The next time shop management wants to bid on a job but can not because it does not have the necessary equipment, they will know where that equipment is located. The bid can then be issued and the necessary work can be subcontracted out, thus allowing more contracts to be won in the local business community and allowing all shops to become more competitive and economically sound.

APPENDIX A

EQUIPMENT EVALUATION FORM

GENERAL MACHINE INFORMATION:

MACHINE # _____

MANUFACTURER _____

MODEL # _____

TYPE OF MACHINE MANUAL N/C
 MILL LATHE GRINDER EDM
 OTHER _____

YEAR OF MANUFACTURE (OR AGE) _____

H.P. RATING _____

WORK AREA X _____ IN. M.M.
 Y _____
 Z _____
 A _____
 B _____
 C _____
 W _____

MAX. WORK PIECE WEIGHT _____ LBS.

ESTIMATED USE THROUGHOUT THE YEAR (%) _____

EQUIPMENT CONDITION INFORMATION:

CONDITION OF MACHINE EXCELLENT GOOD FAIR POOR

If FAIR or POOR explain.

If POOR should this machine be:

SURPLUSED REPAIRED OTHER

If REPAIRED or OTHER explain.

WHAT TYPE OR CATEGORY OF JOBS SHOULD THIS MACHINE BE USED FOR?

WHAT TYPE OR CATEGORY OF JOBS SHOULD THIS MACHINE NOT BE USED FOR?

OTHER COMMENTS:

RETURN ON INVESTMENT INFORMATION:

ORIGINAL COST OF MACHINE \$ _____

YEARS OF DEPRECIATION _____
(SUGGESTED 5 MIN. TO 10 MAX.)

ANNUAL DEPRECIATION (COST / YEARS) \$ _____

ANNUAL MAINTENANCE COST \$ _____
(CONTRACT COST OR SET ASIDE)

ADDITIONAL MAINTENANCE COST \$ _____
(ADDITIONAL CHARGES [PARTS, ETC.] + LABOR +
DOWNTIME COST [DOWN HRS. X SHOP RATE])

ACTUAL ANNUAL MAINTENANCE COST \$ _____
(ANNUAL COST + ADDITIONAL COST)

ANNUAL SET ASIDE FOR REPLACEMENT \$ _____
(SUGGESTED SET ASIDE = 10% OF ORIGINAL COST PER YEAR)

AMOUNT OF REVENUE GENERATED ANNUALLY BY MACHINE \$ _____
(2080 HRS. / % OF USE X SHOP RATE)

INCOME DERIVED FROM MACHINE \$ _____
(REVENUE GENERATED - ANNUAL DEPRECIATION - ACTUAL MAINTENANCE
COST - REPLACEMENT SET ASIDE)

APPENDIX B

EQUIPMENT CONDITION INFORMATION:

CONDITION OF MACHINE EXCELLENT GOOD FAIR POOR

If FAIR or POOR explain.

Because of the age of this machine it has many small problems; spindle runout, override switches, tapers, etc.

If POOR should this machine be:

SURPLUSED REPAIRED OTHER

If REPAIRED or OTHER explain.

The cost of repair and upgrade of this machine is in excess of its market value or cost of replacement.

WHAT TYPE OR CATEGORY OF JOBS SHOULD THIS MACHINE BE USED FOR?

Roughing work, work with tolerances of +/- .005 or greater, nonprecision work, drilling.

WHAT TYPE OR CATEGORY OF JOBS SHOULD THIS MACHINE NOT BE USED FOR?

Precision work, tolerances of +/- .005 or less.

OTHER COMMENTS:

RETURN ON INVESTMENT INFORMATION:

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YEARS OF DEPRECIATION 15
(SUGGESTED 5 MIN. TO 10 MAX.)

ANNUAL DEPRECIATION (COST / YEARS) \$4,815

ANNUAL MAINTENANCE COST \$1,896
(CONTRACT COST OR SET ASIDE)

ADDITIONAL MAINTENANCE COST \$23,000
(ADDITIONAL CHARGES [PARTS, ETC.] + LABOR +
DOWNTIME COST [DOWN HRS. X SHOP RATE])

ACTUAL ANNUAL MAINTENANCE COST \$24,896
(ANNUAL COST + ADDITIONAL COST)

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(SUGGESTED SET ASIDE = 10% OF ORIGINAL COST PER YEAR)

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(2080 HRS. / % OF USE X SHOP RATE)

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(REVENUE GENERATED - ANNUAL DEPRECIATION - ACTUAL MAINTENANCE
COST - REPLACEMENT SET ASIDE)

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An evaluation tool to survey machine tools (in-house), determine condition, and calculate ROI.

12. KEY WORDS (6 TO 12 ENTRIES; ALPHABETICAL ORDER; CAPITALIZE ONLY PROPER NAMES; AND SEPARATE KEY WORDS BY SEMICOLONS)

CNC; machine tool; N/C; ROI

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